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Transit Information: A State of the Art Report

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Transit Information: A State of the Art Report

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1. Introduction

This State-of-the-Art report was initiated by a letter that was recently sent to the transit operators in the Toronto commutershed. The letter introduced the idea of a regional passenger information service and solicited replies on several questions regarding the information service.

Replies to the questions were received and a definite interest in the regional information service was apparent. A State-of-the-Art report was deemed necessary in order to proceed with the overall study of the subject.

Thus the objective of this report is to provide a State of-the-Art examination of passenger information services for large metropolitan areas as an aid to the eventual determination of a suitable service for the Toronto commutershed

For the purposes of this report passenger information is considered to be of three types.

1) Printed Schedules and Maps
2) Displays at Terminals, Bus stops
3) Telephone Information

Telephone information can be handled in a wide variety of ways such as:

i) Manual - Using telephone operators & printed information
ii) Recorded Messages - Which can give route information or prepare the caller to ask the appropriate questions.
iii) Microfiche - Using telephone operators aided by microfiche for faster access of route information. Computer assistance is sometimes utilized.

iv) Automated Passenger Information Services - Computer based transit information. There are two basic types of information given

a) Route Alternatives and Schedule Times - Specific itineraries are given by providing origin and destination points.

b) Bus Arrival Times - The time of arrival of the next bus is given at a specified location. This may be real time or schedule time.

In the Toronto commutershed there are 14 different local transit operators and 6 different commuter service operators. The small transit operators supply telephone transit information using very few people. The telephone operators may work out of the public works department or there might be a small separate department. The large transit properties use many more telephone operators, up to 12 at one time for the TTC. Mississauga Transit has automated passenger information, i.e. 'Easy Rider' which gives bus arrival times (real time). The TTC is in the process of developing their own service similar to Mississauga's . Ottawa is the only other Ontario city with a similar service (schedule time).

The sections of this report were chosen in an attempt to satisfy four major requirements of a State-of-the-Art report on regional information services.

1) What are the characteristics and behaviour of the transit users and how are their transit information demands best satisfied?

2) What services are being operated in some large U.S. cities and what are their operating characteristics?

3) What are some of the recently developed automated services and how do they work?

4) What is the current situation regarding passenger information in the Toronto commutershed?

In some cases there is an obvious lack of information, in this situation it has been indicated that further study is necessary.

Numerous reports have been reviewed and summaries of these reports appear in an appendix along with summaries of the current situation regarding AVM and AFI; two topics that will be discussed later in this report. Several reports have not been reviewed but may be of interest to the reader and are listed under the references

2. Transit User Information Retrieval Habits

2.1 Transit User Opinions and Ridership Studies

In a survey done in the U.S.[1] in 1976 a large number of transit users were interviewed; they were from three cities: Seattle, Columbus and Dallas. The people interviewed were asked a series of questions. One set of questions regarded their attitudes towards public transit. Some results were:most people favoured government support of public transit; people feel a need for good transit service and they felt that the most important feature of it is convenience. The subjects were then asked questions about different types of information. Information aids were rated in the following order, most preferred first:pocket schedule, telephone, bus stop information, fold out map,bus driver, electronic route finder, sign on front of bus,and other people at the bus stop. With bus stop signs graphic symbols were judged more recognizable but less attractive than regular geometric shapes. The preferred colour for transit signs was blue since this is a colour used less often for other traffic signs.

With regard to transit system maps, pocket maps were preferred to large fold out maps. Colour coding and number coding were about equal in preference, mail delivery the best way to distribute maps. Fare payment methods were ranked in the following order: coin, token, then tickets

In a study done for the Transportation Research Board (TRB), in Milwaukee ,1979,[2] it was found that the bus driver was the most important source of information for transit users, with 45.3% of people using the driver as a source of information on , 'bus routes and transfer locations.' and 38.8% of people using the bus driver to find, 'bus stop locations.'

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[1] Transit User Information Aids An Evaluation of Consumer Attitudes

[2] Study of Commuter Choice of Information Source to Improve Transit Information Systems

In the same study it was found that increasing information at the bus stop is worthwhile since it does increase the transit rider use of the bus stop as an information source. The report also presents a transit user behaviour model which shows how the transit rider chooses the type of information he uses. The choice was found to depend on: experience of the commuter, personal characteristics, commuter perception of information complexity, availability of source, reliability of source, nature of trip and time available to plan the trip.

The two studies seem to give conflicting results especially with regards to the bus driver as an information source. This can be explained by the nature of the questions asked In the first study the question was " Which type of information source do you prefer?", while the second study asked " What type do you use?" This indicates that people would prefer to use other information sources but quite often have no other choice but to use the bus driver. The bus drivers might be more helpful in Milwaukee than in the other three cities. The TRB study also introduces a behaviour model which might prove useful in setting up an information service.

In Mississauga following the introduction of an automated passenger information service called Easy Rider it has been observed that ridership has increased 10-13% on weekdays and 20% on Saturdays. The majority of the calls to Easy Rider are made during off-peak hours when headways are largest. Other observations are: off-peak ridership has increased more than peak ridership and transit riders using Easy Rider wait an average of three minutes less at the bus stop because of increased confidence in bus arrival time.

Ottawa's OC Transpo has also observed the relationship between ridership increases and up-to-the-minute information. They observed that increased headways make transit riders fearful of a long wait and alleviated this problem by introducing their own automated telephone passenger information service(1e"560").This improved transit users confidence in the time that the bus would arrive at the stop. OC Transpo also found that ridership was decreased due to meandering routes and multiple transfer points.

2.2 Ontario Transit Operators Opinions

Transit system operators have their own opinions on what are the important facets of an information network. A report[1] done by MTC in Jan/77 deals with some suggestions. The transit map and route guide was ranked as most important by the officials. The transit officials suggested the following: all new residents should receive a transit guide; consumer reaction must be taken into account when developing a guide; step by step travel information should be included in the guide and updates should be done every year with a termination date included on the guide.

Various suggestions were made concerning the other parts of a transit information service. With regard to telephone information, it is suggested that phone numbers for the service be listed under the transit system name or, " Transit Information". The bus stop sign must have a message on both sides of the sign. Detailed information at the bus stop should only be provided if adequate maintainence can be provided; otherwise the information may become difficult to understand or even misleading. Bus drivers may benefit from a public relations course. Telephone calls from the public are considered to be the best source of information concerning public attitudes towards transit.

OC Transpo in Ottawa sees an information service as the best way of increasing cost-effectiveness by increasing off-peak ridership. According to OC Transpo the following questions should be answered by an information program: what route to take; where to meet the bus; where to transfer; when to meet the bus; how to recognize the appropriate bus; how to recognize the point to alight; and what is required of the rider when he uses the system(i.e. exact fare, rules and methods of payment)

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[1] A Survey of Informational, Advertising an d Promotional Activities of Ontario Transit Companies and Attitudes of Transit Officials

3. Passenger Information Systems

3.1 Various System Types

There are basically four different types of passenger information systems

1) Manually Recalled Information

The simplest and most commonly used method is manually recalled information. The telephone operator finds the desired information by simply looking through the transit system maps and schedules. This method is good for small call volumes but waiting time can become too large if call volumes increase. The manual method can also break down if the transit system becomes too complex. The amount of time spent looking for information can become prohibitive

2) Recorded Information

Recorded Information can be used as a major means of supplying information. Different numbers are dialled which supply information on a specific route. Thus operators handle fewer routine calls and call volume is decreased. Recorded information can also be used to help reduce the number of lost calls and the amount of time spent on a call. Recorded messages prepare the caller by telling him what questions to ask, thus reducing the time spent by the operator asking questions The recording can also tell the caller he has reached the transit telephone information service, thus he is less likely to hang up if he is put on hold. The use of recorded information can make it difficult to determine the number of lost calls , since people may receive the required information via the recording.The cost of frequent changes to the messages may become a major problem.

3) Microfiche Information Storage and Retrieval

Instead of hiring additional telephone operators or using recorded messages some transit companies have turned to other alternatives.

The use of microfiche is an example. The microfiche are easy to store and can be incorporated into an efficient retrieval system.Manual retrieval is a simple method, it involves the use of an index in order to find the information. The operator first consults a master index and is referred to a specific microfiche. This microfiche contains its own index, allowing the operator to find the desired information. Another method is electromechanical retrieval. The operator need not search for the information , but simply goes to the master index and enters the appropriate code. Then once again the operator enters the appropriate code on the specific microfiche which is automatically found and displayed. The most sophisticated microfiche system uses computer assistance. The use of indices is bypassed. Required information is simply asked for in normal English or it can be abbreviated. The information is then immediately found and displayed.

With these microfiche systems costs increase as the complexity increases but the time to access the information is decreased. Microfiche systems reduce access time by 10-15% over manual retrieval; computer assistance added to a microfiche system can reduce access time over 15 percent . The microfiche do have inherent problems. You cannot look at two microfiche simultaneously on the same screen, thus making information on complex itineraries hard to provide. The microfiche are only in black and white making coloured maps confusing when converted to microfiche. Operator boredom is increased because of the repeated use of a single information source.[1]

4) Automated Passenger Telephone Information

Automated passenger telephone information is the most flexible and quickest means of information retrieval.Computers allow an origin or destination to be an address, an intersection or a landmark. Other advantages of the system are that it is: quicker easier to update, more accurate and uniform,

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[1]Feasibility of and Design of Cost Effective Computer Based Information Systems to Increase Productivity of Present and Future Urban Transportation Systems

reduces printing costs, can specify alternate routes and times. Unfortunately the cost is very high and only is cost-effective in large urban areas. Care must be taken to ensure that up-to-date printed information is available in case of computer malfunction.

Two types of automated passenger telephone information services are, computer controlled route selection and up-to-the-minute bus arrival time information. The computer controlled route selection is a service which provides a detailed travel itinerary given an origin and destination. This service is discussed in greater detail with actual systems being described in section 4.1 . Bus arrival time services (real time) rely on automated vehicle monitoring (AVM) in order to provide the up-to-the-minute information. The monitoring can be accomplished by a wide variety of methods, one of which is called the signpost technique*. All AVM systems rely on computers to keep track of the information. Experimental AVM systems are being set up in many major urban areas around the world.

Automated Vehicle Monitoring has developed because of the need for up-to-the-minute information on bus location and status. The simplest way to monitor buses is by employing inspectors. Radio telephones can decrease the number of inspectors. AVM has the advantage of being able to supply all the information on a bus without distracting the driver

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*Consult the appendix - Sudbury AVM
- AVM Current World Situation

3.2 Systems in Operation

3.2.1 Descriptions of Selected Systems

On page 12 a list of the large U.S. cities and their public transit characteristics as of 1978 is given. Several passenger information services in these large cities are described below.

In Chicago, a mechanically retrieved microfiche system is used which originally cost $30,000 and which reduced operator training time by 90 percent. The training time is reduced because of the ease of retrieving the desired information, thus the operators don't have to know the system as well. The Northeastern Illinois Regional Transportation Authority in Chicago handles about 7,700 calls a day and has recently initiated an operator training program. The program involves: suggestions on what to ask the caller, listening to tapes of typical calls (in order to test operator responses) and role playing. The program has increased productivity because of quicker call processing and reduced caller waiting time.

Los Angeles is the location of the Southern California Rapid Transit District. The information system here receives 10,000 to 12,000 calls per day. New clerks receive 8 weeks of instruction and take 6 months to become fully qualified. There is a computer controlled route alternative system being developed which can choose up to four different travel itineraries; the operator then chooses the best of these. An automatic call distributer is also being developed. The 120 clerks employed must know a system which has 200 routes and 4,500 square miles of service area serving 185 communities and cities.

The Southeastern Pennsylvania Transportation System has developed a computer assisted microfiche service which has reduced operator access time to less than ten seconds. An overall time saving of 15-20% over mechanical retrieval was accomplished by computer assistance.

Some of the smaller urban areas have developed some innovative information services; a few of these services are examined as follows.

In Santa Clara County, California the information service answers more than 3,000 calls a day. They distribute 731,000 or more articles of informational and promotional literature every month. Representatives for the information service travel about in well equipped vans advertising the transit information service at local events.

The Central Ohio Transit Authority has set up number of booths which use a computer to tell the commuters the possible cost savings of using public transit. The computer compares the cost of operating a private vehicle with the cost of public transit and shows the savings that are possible.

Portland,Oregon uses a system named " Call-A-Bus." The system is operated 24 hours a day and supplies recorded route information on 71 bus routes. Each bus route has its own dialling number. Money has been saved by implementing this system since additional operators do not have to be hired. Operator assisted calls cost the Tri-County Metropolitan Transit District in Portland 40¢ each. This figure is expected to increase 10 fold by 1986. Before the " Call-A-Bus " system was introduced up to 30% of calls were lost, a major problem. The addition of more operators was considered but this would only be a short term solution. Other elements of the " Call-A-Bus" service are: a new comprehensive system map and schedule book,and bus information boards at major transfer areas.

TABLE 1

U.S. Transit Properties (over 1 million population)
In order of number of buses

City	# of Buses	Subway	Commuter Rail	Street Car	AVM
1 NEW YORK	4,550	*	*		
2 CHICAGO	2,400	*	*		
3 LOS ANGELES	2,391		*		*
4 WASHINGTON	2,187	*	*		
5 NEWARK	1,959			*	
6 PHILADELPHIA	1,660	*	*	*	
7 DETROIT	1,272				
8 BOSTON	1,215	*	*	*	
9 ST.LOUIS	996		*		
10 MINNEAPOLIS-ST.PAUL	982				
11 BALTIMORE	969		*		
12 PITTSBURG	903			*	
13 CLEVELAND	840	*		*	
14 OAKLAND	826				
15 ATLANTA	783	*			
16 MIAMI	690		*		
17 SEATTLE	593				
18 DENVER	530				
19 MILWAUKEE	523				
20 SAN FRANCISCO	501	*	*	*	
21 BUFFALO	483		*		
22 NEW ORLEANS	455			*	
23 HOUSTON	438				
24 CINCINATTI	420				*
25 DALLAS	407				
26 SAN DIEGO	362				
27 SANTA ANA	324				
28 COLUMBUS	273				
29 PHOENIX	134				

3.2.2 Special Communication Systems

In recent years a new communication device for the deaf has been developed. The teletypewriter or TTY has been introduced to help the deaf communicate over the telephone. The TTY is in fact a keyboard which transmits the typed message to another TTY. Some transit authorities have seen the rapid growth of TTY use and have installed their own TTY in order to supply the deaf with transit information.

Indianapolis has approximately 10,000 deaf residents in the surrounding area and the local transit authority decided there was sufficient demand to warrant introducing a TTY service. The transit service representatives are also trained in sign language to better communicate with the deaf.

Another TTY service has been set up in the Atlanta area to serve the over 500 TTY units in the Atlanta area. This system was started in October 1980

In Oakland a toll free TTY number was introduced in July/79 to serve the high demand for TTY service. The high demand can be attributed to the presence of the California School for the Deaf in the Oakland area.

Los Angeles transit information service answers 60 calls a month from some of the 3,000 TTY owners in the greater Los Angeles area.

Some other unusual communication ideas have been developed. In Santa Clara County , California they have developed a format for translating transit schedules into braille for use by blind information service operators. Milwaukee has introduced language cards which answer commonly asked questions. The languages the cards are written in are German, Italian, Polish and Spanish (the most common languages in the area after English)

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*These descriptions appeared in recent editions of Passenger Transport (July/80-July/81)

3.3 Experiences with Regional Information Systems

A recent study[1] in the U.S. by the Urban Mass Transport Administration has indicated that problems should be expected to occur with the implementation of a regional information service. A few of the major problems are listed below.

- Incompatibility of operating procedures and conflicting goals for the information service

- The importance of informing patrons of all transit agencies that can supply their required transportation.

- Transit agencies must agree on a common format in order to reduce costs due to the preparation of a unified set of information; this would also reduce operator training time.

- Care must be taken in order to avoid conflict between participating transit agencies. A source of severe conflict is advertising, one company could advertise heavily and its business might go to another nonadvertising company.

Most problems associated with a regional information service occur at the time of set up, so it has been found a good idea to hire temporary staff as extra personnel at the time of set up.

A regional information centre has been set up in Rochester, New York for the Rochester-Genessee Regional Transportation Authority. The centre serves the Regional Transit Service patrons. The centre has experienced significant increases in enquiries; a year ago 1,000 calls per day were received this figure is now 1,300 calls per day .First time riders use this service extensively

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[1] Transit Telephone Information Services

4. Automated Passenger Telephone Information Services

There are two basic types of automated passenger information

4.1 Automated Passenger Information For Choosing The Best Route

The services which give various route alternatives are both located in Europe. In Hamburg the AFI service is currently being tested. The route information can be given by telephone or at a " travel automat ", which is a computer terminal. The user enters his/her destination, if at an automat, by looking up the code number in a provided list. The starting point is assumed to be the automat. A travel itinerary is given on a slip of paper which lists: the apppropriate buses; up to 3 transfer points; and departure and arrival time. If the inquiry is by telephone, the destination starting point along with the departure time must be specified. This is done by dialling the information into the computer. The reply is in synthetic speech.

The AFI data base contains codes for 14,000 street names, 2,300 names of stops or stations and 700 names of important destinations. The transit user obtains these codes by use of a microfiche at the automat. When selecting the final route the computer takes into account various criteria, such as travel time and transfer time. The appropriate itineraries are then short listed and the final choice is decided upon by some additional factors. These factors are: rapidity of journey, convenience and cost. The testing of this project was completed at the end of 1979, in the appendix recent updates are summarized.

The second service giving route alternatives is located in Wiltshire county, England.The system was designed by the Transportation and Road Research Laboratory (TRRL). It works

on the same basic principles as AFI except that it is more flexible, in that it can accommodate many more route alternatives and options. Another difference is that the TRRL service is set up for intercity use , while AFI is set up for urban areas.

The options that can be handled by the TRRL service in considering the best route are; avoiding backtracking or looping through the same exchange more than once, quickest, easiest, cheapest, type of transit mode, if transfer points are close enough for a walk link, interchange times, origin/destination zones rather than specific points. The printout lists up to ten alternatives along with complete route information. The schedule has a counterpart return trip schedule linked by a route code

Los Angeles, as mentioned earlier, is developing its own service for choosing the best route. No information is available at the present time.

4.2 Automated Information on Bus Arrival Times

Services which give up-to-the-minute location reports rely on AVM for their information.There are three systems in Ontario described below.

Mississauga has set up an advanced telephone information service called, " Automatic Bus Passenger Information" or ABPI. The bus positions are monitored by a small mobile terminal which counts wheel revolutions and determines schedule adherence. The bus is polled every 30 seconds in order to determine its status. Passenger information is supplied by ERICA (Easy Rider Information Computer Assisted). The information is obtained by dialling " 276-route number + bus stop number". The computer uses the dialled number as input and refers to the latest polled position of the bus. The information is given to the caller in simulated speech. Estimated time of arrival for the next two buses is given. Mississauga has 20 routes of which 6 are part of the ERICA service.

In Toronto the name of the AVM system is CIS or " Communication and Information System". The passenger information of CIS is in the pilot project stage and will be similar to the Mississauga service. The information will be tested in the TTC enviroment which in general has shorter headways and more routes (103) than Mississauga. The use of television type-terminals is being investigated with a terminal already located at the Wilson subway station. The buses are monitored by use of sensors attached to the bus wheels, to count wheel revolutions, and by microwave "signpost" transmitters. Proposed is an automatic voice telephone information service as in Mississauga.

In Ottawa OC Transpo operates an automatic voice telephone information service called "560". The information is obtained by dialling "560 - bus stop number", unlike Mississauga seperate routes are not specified. Various other messages can be given along with the scheduled arrival time of the next two buses. The service operates with 20 telephone trunk lines and can handle 3300 calls per hour 10-15 times more than the conventional service in operation before "560".

5. Current Passenger Information Services in the Toronto Commutershed

5.1 Local Transit Services

Table 4 provides a brief summary of the local transit service characteristics. As illustrated by the exhibit, there are 14 local transit operators ranging in size from two vehicles with one route in Aurora to over 1,800 surface vehicles and 103 routes with the TTC. The TTC service carried approximately 1.2 million passengers per day which is significantly more than the next largest transit property, Mississauga which accomodates 90,000 passengers per day. The majority of these services are small with fewer than 20 vehicles. A large number of these services are operated by private contractors.

All of the services provide printed route and timetable information, usually with the route and schedule combined. The TTC provides a separate route map with pocket schedules for some individual routes.

All services provide telephone information. The most sophisticated telephone information system is operated by Mississauga Transit, as described earlier. Mississauga employs three telephone operators to provide more detailed information on services during normal working periods (8 a.m. to 6 p.m.). The TTC provides a telephone operator information service seven days from 7 a.m. to 11:30 p.m.. During peak periods 12 operators are employed, accommodating over the course of a typical day 5,200 calls.An AVM system is currently being tested which may lead to an automated passenger information system.. The majority of other public transit service operators provide telephone operator information service through the local public works.

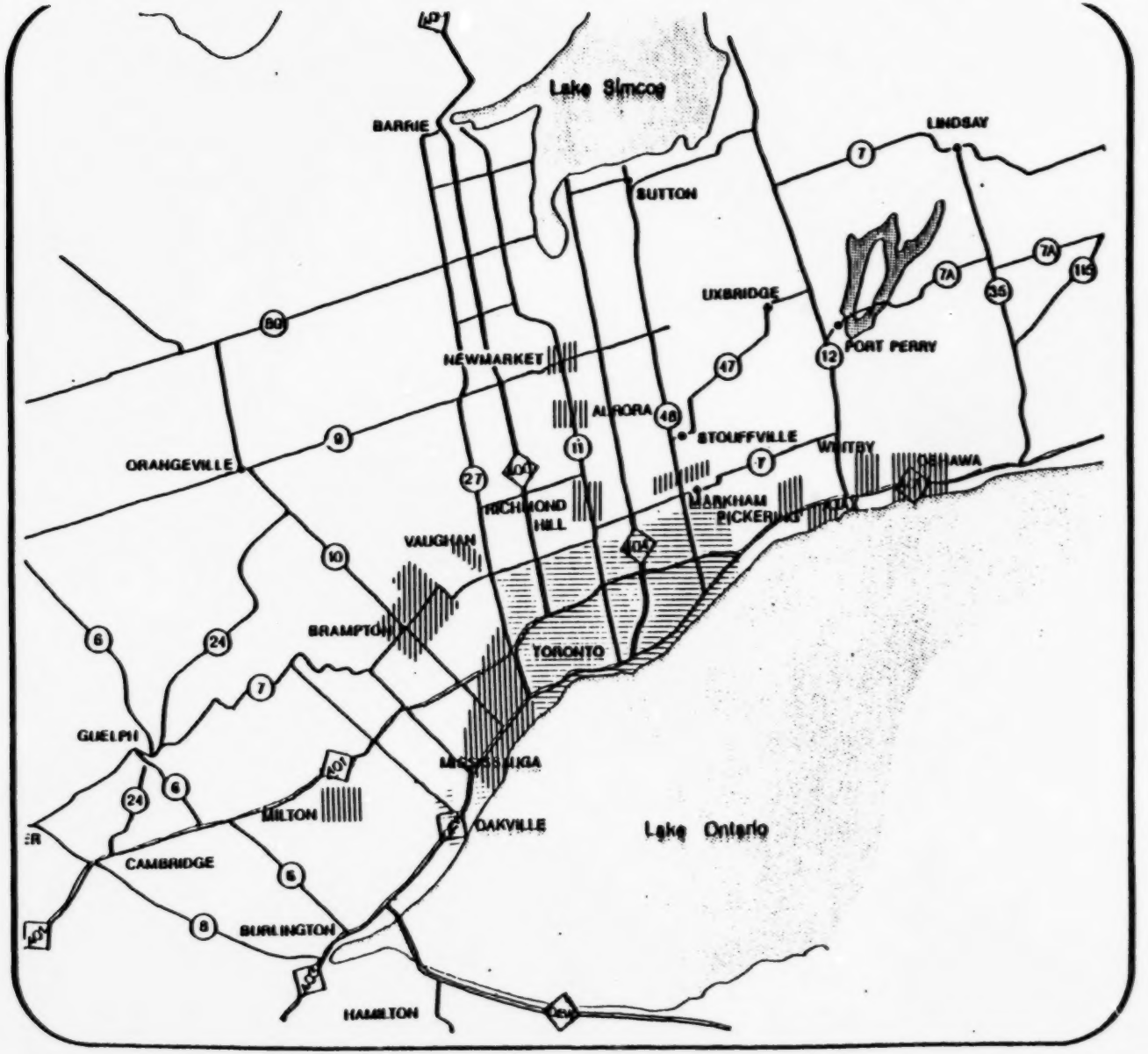
EXHIBIT 2

REVIEW OF TRANSIT INFORMATION SERVICES

COMMUNITY	OPERATOR	NO. OF BUSES		NO. OF ROUTES		INFORMATION SERVICES								
								HOURS OF OPERATION			NO. OF OPERATORS		NO. OF CALLS	
		Total	Max. On Road	Rush Hours Only	Full Service	ROUTE MAP	SCHEDULE/ TIMETABLE	TELEPHONE INFO.	Weekdays	Saturday	Sunday/ Holiday	Total	Max. at One Time	Week Days	Week Ends
Ajax	Charterways	3	3	-	3		Combined	•[1]	9:00 a.m.- 5:00 p.m.	6:00 a.m.-	7:00 a.m.-	-	1	2-5	-
Aurora	Travelways	2	2	-	1		Combined	•[1]	8:30 a.m.- 4:30 p.m.	-	-	-	1	2-5	-
Brampton	Brampton Transit	40	35	6	15		Combined	•[2]	6:00 a.m.- Midnight	6:00 a.m.- Midnight	-	-	2	200	50
Markham	Travelways	15	11	-	8		Combined	•[1]	8:30 a.m.- 4:30 p.m.	-	-	1	1	40 -50	-
Milton	Lewis Bus Lines	4	4	2	4		Combined	•[3]	24 Hours	-	-	1	1	5	-
Mississauga	Mississauga Transit	150	100	2	22		Combined	•	8:00 a.m.- 6:00 p.m.	-	-	3	3	800 1000	-
								Easy Rider	24 Hours	24 Hours	24 Hours	10 trunk lines		4000 5000	1000 4000
Newmarket	Travelways	5	3	-	3		Combined	•[1]	8:30 a.m.- 4:30 p.m.	-	-	-	1	5-20	-
Oakville	Oakville Transit	30	25	-	8		Combined	•[4]	8:30 a.m.- 4:30 p.m	-	-	-	2	60 80	-
Oshawa	Oshawa Transit	39	32	2	11		Combined (Individual brochures for each route)	•[5]	5:00 a.m.- 5:00 p.m.	5:00 a.m.- 4:00 p.m.	TAS	-	3	400 600	50 100
									5:00 a.m.- 10:30 p.m.	TAS					
Pickering	Pickering Transit	13	11	Dial-A-Bus			Combined	•[6]	5:00 a.m.- 1:00 a.m.	5:00 a.m.- 1:00 a.m.	-	3	1	5 10	-
Richmond Hill	Travelways	4	3	-	3+2		Combined	•[2]	24 Hours	24 Hours	24 Hours	-	1	5 10	-
Toronto	TTC	1484 360 (st. car)	1300 320 (st. car)	-	103	o	Pocket Schedules For Some	•	7:00 a.m.- 11:30 p.m.	7:00 a.m.- 11:30 p.m.	7:00 a.m. 11:30 p.m.	29	12	5200	5200
Vaughan	Travelways & TTC	2 5	2	-	2 3		Combined - separate guides for each area	•[2]	24 Hours	24 Hours	-	N.A.	1	15 20	10
Whitby	Charterways	4	4	-	4		Combined	•[4]	8:00 a.m.- 3:00 p.m.	-	-	-	1	25	-

FOOTNOTES:

1. Transit information provided by town staff during regular office hours, or can be obtained directly from operator.
2. Transit information provided by general office staff during office hours and by dispatch/operations staff.
3. Transit information phone line direct to transit operator's home.
4. Transit information provided by town staff during office hours, not available at other times.
5. Transit information provided by dispatch staff during regular office hours, by operations staff during evenings and Saturdays and by an ans g se at tim



Local Transit Service Areas

EXHIBIT 3

5.2 Commuter Transit Services

Table 5 summarizes the general service and information systems of the major commuter services in the study area. The largest is the GO service with four major rail commuter services and nine GO bus services. The GO train service accommodates 41,000 passengers per day and the GO bus service 25,000 passengers per day.

Other operators include VIA rail, Voyageur Bus Lines, Grey Coach lines, Penetang-Midland Coach Lines and Travelways. Relative to the GO service, these have a smaller impact on commuting within the study area. The most predominant characteristic of all the commuter services is that they focus on the downtown core of Toronto.

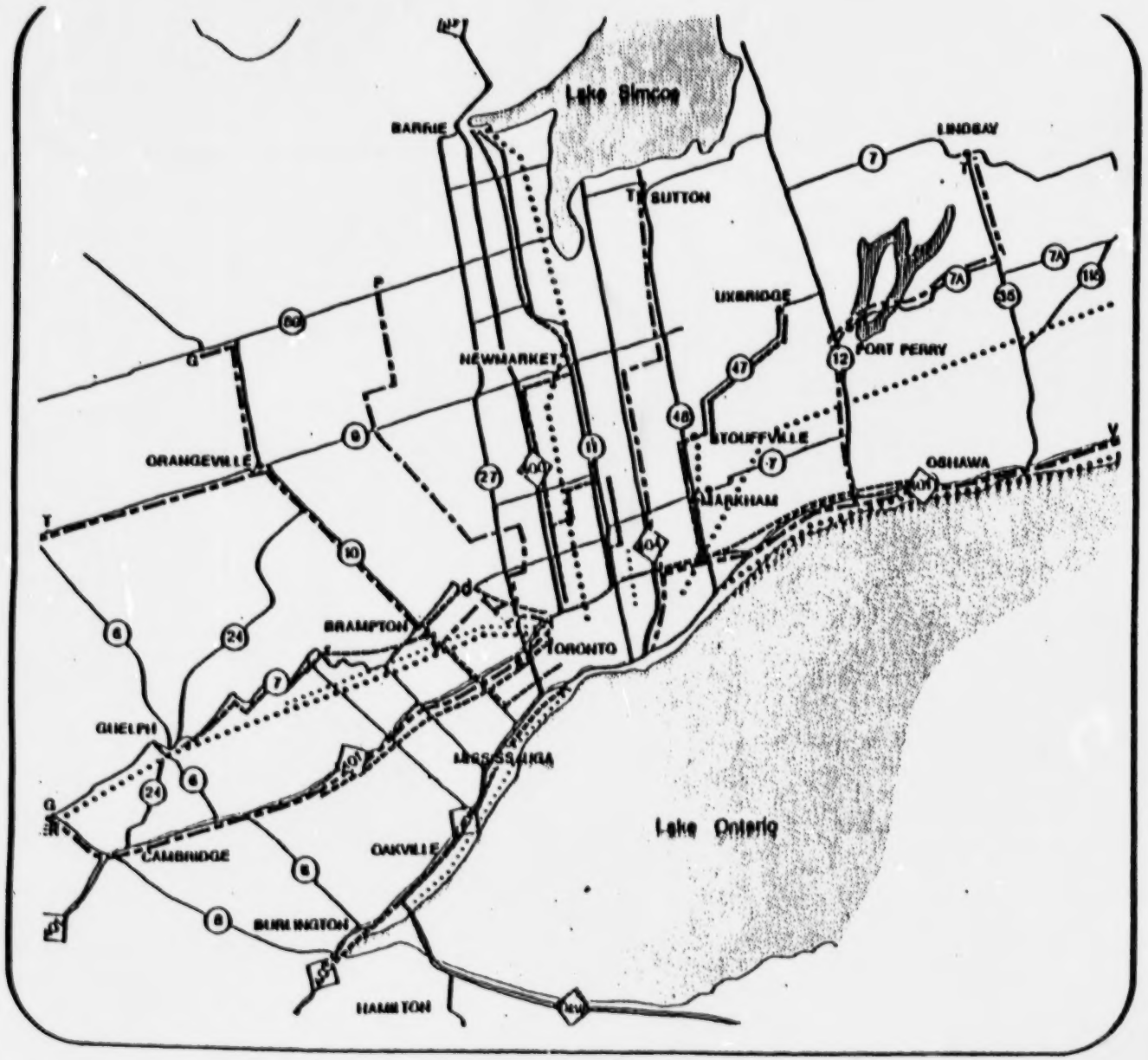
In terms of information services, GO Transit has three to four telephone operators providing information services between 7 a.m. and 11 p.m. . All other operators combine their information services: service information for Voyageur, Grey Coach, PMCL and Travelways are provided by the respective office staff; VIA Rail information is provided through the reservation operators.

EXHIBIT-4

REVIEW OF COMMUTER TRANSIT INFORMATION SERVICES

	SCHEDULE/ TIMETABLE	TELEPHONE INFO.	HOURS OF OPERATION			NO. OF OPERATORS		NO. OF CALLS	
			WEEKDAYS	SATURDAY	SUNDAY/HOLIDAY	TOTAL	MAX. AT ONE TIME	WEEKDAYS	WEEKENDS
VIA Rail	•	•	24 Hours	24 Hours	24 Hours	64	60[1]	10,000	5,000
GO Transit	•	•	7:00 a.m.-11:00 p.m.	7:00 a.m.-11:00 p.m.	8:00 a.m.-11:00 p.m.	16	5	1,700	200
Gray Coach Voyageur & Travelways	•	•	7:00 a.m.-11:30 p.m.	7:00 a.m.-11:30 p.m.	7:00 a.m.-11:30 p.m.	-	16	N/A	
PMCL	•	•[2]	7:00 a.m.- 6:00 p.m.	7:00 a.m.- 6:00 p.m.	7:00 a.m.- 6:00 p.m.	-	9	1,000	500

1. Reservation/ticketing and information.
2. Provided by office staff.



Commuter Service

- ..... GO Trains
- ..... VIA Rail
- ——— GO Bus
- V——— Voyager
- G——— Gray Coach
- P——— Penetang–Midland
- T——— Travelways

EXHIBIT 5

6. Conclusions

According to transit users the best way to receive transit information is by a pocket schedule, as it is compact and easy to use. Telephone information is the way most transit companies keep their customers informed and virtually all transit companies have some sort of telephone information.

Supplying up-to-the-minute transit information on bus locations has been seen to increase ridership both in Mississauga and Ottawa. The major reason for the increased ridership is the decreased waiting time due to the added confidence in bus arrival times. The increases in ridership are observed mostly in off-peak times which helps to increase the cost-effectiveness of the transit system.

Manual information retrieval by operators is the most commonly used method of supplying transit information. This type of service works fine unless call volumes become too large or if the transit sytem becomes too complex. These problems can be overcome simply and with reasonable cost. An example is Chicago's mechanically retrieved microfiche system which cost $30,000 and reduced operator training time by 90%. In general microfiche systems relying on manual or electromechanical retrieval reduce information access time by 10-15%. This reduction exceeds fifteen percent if computer assistance is used as in the Southeastern Pennsylvania Transportation System.

A second method of handling high call volumes is the use of recorded messages. In Portland, Oregon such a system is used and this avoided the hiring of additional operators, a substantial cost savings.

The most advanced method of supplying transit information is automation. There are two major types of automated services. The first gives public transit itineraries between any two specified locations. Systems have been tested in Wiltshire County, England and Hamburg, West Germany. In Hamburg the AFI service is being tested and among a sample group of Hamburg citizens it was found that the AFI service was having a positive effect. The tested individuals surveyed indicated that because of AFI 16% of their number had used the service in the previous 6 months.

This trend should result in sizable increases in ridership once the AFI service is offered to all the people of Hamburg, which is planned for the near future (approx. 1982-83).
The other type of automation has also resulted in increased use of public transit. The services which give bus arrival times have recorded large increases in off-peak ridership, when the advantages of knowing the bus arrival times is the greatest. During off-peak times headways are large and this results in longer waiting times normally. This type of service has only been found to exist only in Ontario, no other similar service was found outside this province. In Mississauga ridership increases during the week were 10-13% and 20% on Saturdays. In Ottawa preliminary observations have shown significant ridership increases.

The use of TTY is becoming widespread with cities as small as Indianapolis (750,000) feeling there is sufficient demand for this service. The cities of Los Angeles, Atlanta and Oakland have incorporated TTY as part of their transit information service.

In the Toronto commutershed, the large number of transit operators, ie. six commuter and fourteen local transit operators, emphasize the need for a coordinated approach to the provision of passenger information.

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12 Transit Office MTC Monitoring Report - Subway Automatic Vehicle Monitoring System, August 1979

13 Washington Metropolitan Area Transit Commission. Transit Information Aids U.S Department of Transportation, Urban Mass Transportation Administration, Washington D.C., 1970 (PB - 196329)

14 Wilson N.H.M., Colvin N.J. Information and Control Systems for Paratransit Services, Urban Transport Service Innovations, SR 184, Transportation Research Board, Washington D.C., 1979 page 95

NOTE - THE ABOVE REPORTS ARE LISTED IN THE APPENDIX IN THE SAME ORDER AS ABOVE. THE FOLLOWING REPORTS ARE LISTED AS REFERENCES BUT WERE NOT REVIEWED

1 IBI Group Area Wide Carpooling Matching and Transit Information Study, Ministry of Transportation and Communication, Policy Planning and Research Branch, Toronto, June 1981

2 Supporting Information Aid Systems (TRB) 16 302121

3 Traveller Information Needs (NTIS) PB 274 360/7GA

4 Evaluation of Cincinnatti Transit Information System (NTIS) PB 300 355/5GA

4 Applicability of Digital Data Communication Features in Public Transit Systems: Executive Summary (NTIS) PB 296 369/2GA

5 Applicability of Digital Data Communication Features in Public Transit Systems: Technological Assessment (NTIS) PB 296 379/1GA

APPENDIX

-REPORT SUMMARIES

-AVM CURRENT WORLD SITUATION

-AFI - AN UPDATE

Better Information Equals More Riders - OC Transpo

By John A. Bonsall and Mary S. Whelan

Purpose - More effort needs to be made to improve transit productivity through greater utilization of existing services. OC Transpo has concluded that a better information system is vital to accomplish this goal.

Contents -

1. OC Transpo Operations
   Transit ridership only increased 3% in 1980 and is projected to increase only about 3% in 1981. The limit growth, as compared to the 10-12% growth in the mid 70's, is due to a slower population growth rate. The figures also show that new ridership must be attracted from automobile users.

   This growth, although the hardest to achieve, will make the largest contribution to reducing energy consumption.

2. Transit Service and Productivity
   OC Transpo has concluded that a good information system is necessary to improve efficiency. The reverse is also true: a good information system makes it easier to take advantage of efficiency improvements.

   The basic reasons for low bus usage during off-peak hours are; meandering routes, multiple transfers and user knowledge of routes is lower. One of the important reasons off peak usage is so low is that the transit user fearfull of a long wait. If these fears could be aleviated by supplying status information for the particular bus stop a transit user wishes to use, the problem of uncertain waiting would be removed.

3. Transit Information program
   An information program should answer the following questions

   - what route to take
   - where to meet the bus/where to transfer
   - when to meet the bus
   - how to recognize the appropriate bus
   - how to recognize the point to alight
   - what will be required of him when he uses the system (i.e. exact fare, rules and methods of payment)

   OC Transpo decided the following factors are important in satisfying a users requirements

   - the bus curtain sign must be used only to indicate the direction the bus is travelling i.e. destination.
   - a detailed route map must be at all bus stops
   - fare information should be displayed at bus stops as well as on the bus.
   - bus schedules should be given for every stop
   - to minimize waiting time, the passenger has to know when the bus arrives before he leaves for the stop.

   OC Transpo set about solving the above problems by implementing

the following information programs components.

- standardizing the destination signs and reducing the number of different signs
- posting of information at all bus stops
- posting of system maps at high traffic sites
- fitting the buses with a 3 digit route number
- the installation of an automated telephone information system

4. Automated Telephone Information Systems
Automation allows the quick processing of information on route changes or scheduling and allows the presentation of information on a bus stop level.

The automated system, "560", was originally implemented in the area which is east of the Rideau river. The system is designed to give the rider the scheduled arrival of the next 2 buses at his stop, the status of the; route he requires, or the whole system.

The dialling of "560" puts him in contact with the computer and then the stop number is dialled into the computer, no route number is required. He then receives the schedule information, along with status information, i.e. delays also he can receive information of schedule changes.

The systemoperates with 20 telephone trunks and can handle 3300 calls per hour, which is 10-15 times greater than conventional telephone information systems.

5. Cost and Benefits
It is anticipated that the system will generate additional revenue of $1.11 million due to 2.6 million additonal rider, this is based on field results obtained. The system will cost $660,000 and an additional cost of $100,000 will be incurred giving a cost benefit ratio of 6.5 to 1 over 5 years.

A survey of Informational, Advertising and Promotional activities of Ontario Transit Companies and Attitudes of Transit Officials

By Brian Deslauriers Human, Social and Economic Research, MTC 1977

Purpose: 1) To determine what aspects of transit marketing are considered most important
2) To document the various strategies that are being pursued
3) To provide suggestions to aid transit operators in maximizing the effectiveness of their transit marketing activities.

Contents: The report looks at the responses to the questionnaire sent to all 45 urban transit operators in Ontario, 43 questionnaires were returned. The report also contains the results of personal interviews with 9 transit companies.

The transit companies divided into 3 groups for comparison purposes. Group 1 has 45,000 people or less, Group 2 - 120,000-46,000, and Group 3 greater than 120,000. The transit marketing actions of these 3 groups are then compared.

Sections on Transit guides, telephone information, bus stop signs, bus drivers and information from the public are also included.

Conclusions: Transit guide rated as the most important marketing activity. Based on the survey various suggestions are made
i) New residents must receive a guide, with the welcome wagon being the best way to distribute the guide
ii) Customer reaction must be taken into account when designing the guide
iii) Very detailed information is required.
iv) Guides should be updated every year, with a termination date supplied, rather than a effective date.
v) Advertisements in the guide help to reduce costs.

Telephone Information

The listings in the phone book are sometimes hard to find, it is suggested that the number for transit information be listed under the name of the system or "Transit Information".

Bus Stop Signs

The sign must indicate a bus passes by the spot, this is accomplished by having the message on both sides of the sign. Detailed information at the bus stop should only be provided if adequate maintenance can be provided, otherwise the information may become misleading.

Bus Drivers

In many cases the bus drivers would benefit from a public relations training course.

Information from the public

Telephone calls from the public are considered the best source of information about the public attitudes towards transit. The most effective surveys are telephone and household surveys. On-bus surveys get poor results because of the lack of time and too bumpy a ride. Mail back surveys usually suffer from a lack of interest.

Feasibility of and Design of Cost Effective Computer - Based Information Systems to Increase Productivity of Present and Future Urban Transportation Systems

By John W. Drake and Richard P. Guenther Perdue University

For U.S. Department of Transport

Purpose - to examine all forms of telephone information systems and to analize the interplay of telephone information with other related information sources. Based on a discussion with 39 city transit officials.

Contents

1. An Overview of Transit Information Services
   - transit system should be competitive with taxi or automobile
   - can do this by supplying appropriate information i.e. - what route to take, where and when to board the bus, how much it costs, where to get off, what transfers are required, trip duration, time of the first/last service of the day, walking time between vehicles and the likelihood that the vehicle will be on time
   - problems with written material - are often difficult to read and use, may not be widely distributed, may not be available when the need arises, become outdated, cannot handle special situations
   - problems with telephone information - receive busy signal, long delays while operator finds information, problems communicating because phone information user doesn't know what he wants

   Some transit companies oppose automated transit information for various reasons

   i) lose the human touch
   ii) too expensive for small operators
   iii) unable to handle complex data

   Transit Information Centers
   - provides maps, schedules, other informational or promotional items
   - answers questions in person or by telephone
   - expensive to maintain

2. Improving Conventional Transit Information Services

   a) Graphics
   - provide on-the-spot information to the traveller
   - problem with keeping information up to date can be overcome by
     i) make changes in routes and schedules less often
     ii) accumulate changes and put into effect at the same time
     iii) produce changes on self-adhesive labels, computer generated

b) Terminals/Transfer Points

- "you are here" maps
- automatic dialling to a transit information center

3) Telephone Information Services

a) Benefits

- information easy to understand
- personalized service
- access to timely information

b) Problems with Manual Information

- requires many operators
- amount of information becomes hard to handle
- larger the system, the more changes
- likelihood of errors increase
- likelihood of caller receiving a busy signal increases

c) Advanced Systems

i) Recorded Message

- used at peak times
- caller given some information while waiting for operator i.e. how to ask questions, route status

advantages

- caller can ask questions easier
- operators handle fewer calls
- callers know they have the right number

disadvantages

- cost of frequent changes
- hard to determine number of lost calls

ii) Microfiche Display Units

- all relevant information on microfiche
- can be recalled manually or electromechanically

advantages

- information more quickly obtained than in paper system
- large amounts of information in small area
- average time per call reduced by 10-15%

disadvantages

- high cost
- cannot look at 2 microfiches simultaneously
- no color in microfiches
- increase in job boredom for operators

iii) Computer Controlled Microfiche Unit

- CRT Terminal

advantages

- use of minicomputer makes it more flexible
- save time, don't consult index

disadvantages

- much more expensive

iv) Vehicle Monitoring

- vehicle status intergrated into information system
- various systems used to monitor buses
- bus position determined to allow estimated arrival time

v) Computer Augmented Information

Features

- allows an origin or destination to be an address, an intersection or a landmark
- spelling corrector
- informational retrival much quicker
- easier to update
- paper and printing costs reduced
- more accurate and uniform information
- can list future changes in the system
- easy to specify alternate routes or times

Disadvantages

- computer malfunction would necessitate paper information use, maybe out of date
- more expensive

Trial operation of a computer - controlled transit system (AFI) for passengers in Hamburg.

By Prof. Dr. - Ing. Walter Grabe
Hamburger Verkehrsverbund

Purpose: to develop a system of information such that users would be able to obtain all the data they required for the planning and realization of their journeys with a minimum of effort on their part.

Contents:

1. The setting up of a computer system is justified
   a) studies carried out by studiengesellschaft Nahverkehn indicated the need for improved information systems.
   b) widespread resistance to written information
   c) all information required for journey should be acquired with a minimum of effort.

2. Organization of the project
   The project is being run by Dormier system, Hamburg Transport association and SNV studiengesellschaft Nahverkehn and is scheduled to run between 15.12.1977 to 31.12.1979

3. How the system works
   a) If at a travel automat, the user looks up his destination address on the microfilm reader this destination will have a code number. The code number is entered into the automat along with the fee. The terminal works out the best route and prints out the trip voucher.
   b) If obtaining information by telephone, the user looks up both departure and destination site codes, the day of the week, the date and departure time. This is then dialled into the computer. The computer works out the best route and transmits this information by use of simulated speech.

4. Meeting user requirements
   a) Route selection process
      i) searching out possible routes - the routes are selected in stages according to the number of transfers, with 3 transfers being the maximum
      ii) The number of routes selected is reduced by applying various criteria such as travel time, and transfer time. The remaining routes are then short listed and full journey data is found.
      iii) Ascertaining full journey data-the necessary information is obtained, such as departure time, arrival time, transfer points and fares.
      iv) Final evaluation - the appeal of the route is considered in selecting the final choice. The appeal of a route takes into account the rapidity of journey time, convenience and cost.
   b) Using the travel information automats -
      The destination selecting is always with respect to the location of the automat. The microfilm reader contains 14,000 street names, 2,300 names of stops or stations and 700 names of important destinations.
   c) Data output via simulated speech -

The VOTRAX speech synthesizing system (Vocal Interface Division Vs-6-63) was selected for use. The advantages of the VOTRAX system are:

- the advanced stage of development
- the available vocabulary
- costs involved in making alterations to the original program were known.

The VOTRAX system is capable of producing 63 basic sounds which can be called upon to form the desired text.

5. Trial Operation. The system was tested in Hamburg with 5 automats and 5 telephone lines. The telephone lines can handle an average of 27 calls per hour total. The loss ratio is kept at or below 1% with this user volume. Measures to limit calls to the system were necessary to avoid overloading.

   Studies and surveys were conducted during the testing and these results will determine if the full system will be implemented.

6. Developments and Applications of the system-
   The use of alphanumeric symbols could replace the code numbers.

   The system could be expanded to allow for various information centers which could print timetables or display information on a screen.

   The range of information could be expanded to include fare structures, changes in routes, etc.

Easy Rider - The Mississauga Demonstration of the Automatic Bus Passenger Information Concept

By IBI

For Transport Canada - Urban Transportation Research Branch

Purpose - To increase the attractiveness of transit by making information about the times of arrival of buses at the nearest stop of a would-be transit rider.

Contents:

1) Description of Service

   a) name of the service is "Automatic Bus Passenger Information" or ABPI

   b) Operation - to make contact with the Easy Rider Service the digits 276 are dialled followed by 2 digits which indicate route number and 2 more digits indicating the step number.

2) System Description

   Consists of small mobile terminals interfaced with the mobile bus radios. A wheel revolution counting device is connected to the terminals. The mobile terminals have buttons to reset the wheel revolution count and can indicate if the bus is in service. The Mississauga Transit office has a dual minicomputer which locates, determines the status and predicts the arrival of the b ses.

   Every 30 seconds the bus is polled to determine its status. A Voice Response System allows the computer to respond to calls with a automatically composed voice. The system is linked to the telephone and is activated by dialling 276.

   The system can also allow the observation of the buses by use of a TV - type monitor and keeps a log of the schedule adherence of buses.

3) Results

   Following introduction of Easy Rider

   a) very intensive use of service
      ie. 300 - 500 calls per 1000 revenue riders

   b) large ridership increases 10 - 13% weekday and 20% for Saturdays in the first year, expected to increase to 25 - 33%

   Calling Rates

   On Route 6 rates increase 6 times from 75 calls/1000 revenue riders to 462 calls/1000. This shows the system was used in about 20 - 30% of the trips. On Saturday the calling rates increased to 1600/1000 thus virtually everyone who rode had called.

The difference of 25% between peak and off-peak volumes 1977 to 1978 was reduced to 21%. The difference of 57% between morning and afternoon peaks is reduced to 45% and the summer peak was only 7% higher than the winter peak and was 11% before the survey, showing that Easy Rider is very benefical in poor weather where times are uncertain.

4) Prediction Accuracy

On route 6 the bus arrives at a stop between 1 minute before and 3 minutes after 80% of the time. 15% of the remaining buses arrive 4 to 8 minutes late and very few are later than this.

On the newer routes the accuracy is poorer. About 60 - 70% of the time, buses are between 1 minute early and 3 minutes late.

5) Waiting Times

Easy Rider users on average spend 3 minutes less waiting for the bus than non-users. In both cases the margin of safety is large compared to the total waiting time.

The waiting time could be reduced to 1 or 2 minutes if the buses didn't leave the stops before the Easy Rider quoted time.

6) Cost Effectiveness of Easy Rider

With Easy Rider it is possible to increase headways by 20 - 50% and suffer no loss in passenger or revenue, by about 20% over 5 years or reduce costs by 10% for an annual saving of $1,000,000 using the Easy Rider.

The benefit/cost ratios obtained by a 100 bus company is about 4 (2.7 - 7) is half of the computer/communication costs are allocated to Easy Rider and about 2.3 (1.5 - 4) if all computer/communcation costs are allocated.

Communication and Information Systems Development Program
TTC - Pilot Project Evaluation Phase V - Feb. 1980

By IBI Group

For MTC & TTC

Purpose:

To assess the extent to which benefits due to the availability of a communications and Information System (CIS) measure up to the original expectations for the system and whether these benefits are sufficient to warrant the investments which would be required to implement CIS for TTC surface vehicle operators.

Contents:

1) Automatic Passenger Information Services - New Applications

   i) Passenger information displays in all subway stations for all Wilson division routes.
   ii) Display of major delays on Wilson division routes for the marketing and community relations department.
   iii) Development of automatic voice response sub-system for the provision of actual vehicle arrival times at bus stops, automatically, to passengers telephoning a predetermined number. Test could be conducted on the long headway routes of Senlac, Wilson Heights and Faywood initially.

2) Passenger Information System - Pilot Project

   A passenger information display was developed and installed in the Wilson subway station in January 1980. The display uses a television type screen located in the concourse of the station.

   The display indicates the route number loading level and waiting time for the next two buses. The display can also indicate reasons for unusual delays. The display is operated by the Wilson Control Center computers using information from the control system.

3) Recommendations

   i) Passenger Information Displays
   Wilson station display should be tested and evaluated to determine:
      a) if passengers benefit from the display
      b) determine if the application should be extended to other subway stations
      c) determine if the application should be extended to major bus stops and transfer points
   ii) Automatic Passenger Information
      - Mississauga type system
      - should be tested in TTC environment
      - must determine operating parameters for pilot project

Now that the basic control and reporting functions of CIS have been established, passenger information should be given high priority.

Evaluation Procedure

A series of "before" and "after" ridership surveys will indicate growth and percieved passenger benefits.

Duration: 1½ - 2 years for pilot project.

Transit User Information Aids:
An Evaluation of Consumer Attitudes

By Battelle Memorial Institute, Human Affairs
Research Center and Ilium Associates, Inc.
February 1976

For U.S. Department of Transportation
Urban Mass Transportation Administration

Purpose: To identify the necessary components of an effective transit information program which will provide the appropriate types and levels of information for persons to sucessfully use a transit system.

Contents: Surveys of the public concerning the assessment of the value of aids in stimulating and assisting effective use of the transit system. These surveys were conducted in 3 U.S. cities Seattle with 122 people, Columbus 79 people and Dallas 100 people.

These cities were selected because they are all large urban areas 1-1.5 million people and the transit systems in all three locations are quite progressive.

Conclusions:

Attitudes towards Public Transit

- Most people favored governmental support of transit
- people feel a need for good transit systems
- feel that transit primarily has convenience features

Preference for Information aids

- the pocket schedule was ranked first by the people interviewed
- It had a mean rank of 2.28 out of the 8 items considered, this means on average it was about second in everyones list.
- the lowest ranking was given to, other people at bus stop which had a mean rank of 5.84.
- the remaining aids, telephone, bus stop information, fold out map, bus driver, electronic route finder and sign on front of bus had ratings of 3.29, 3.56, 4.24, 4.24 and 4.55 respectively.

Bus Stop Signs

- special graphic symbols were found more recognizable but less attractive
- blue most identifiable

Transit System Maps

- pocket map preferred over the larger fold out map
- colour coding and number coding about equal in preference
- mail delivery was judged the most effective way to distribute the route maps

Fare Payment

- Payment methods were ranked in the following order, coin, token then tickets

Comments: This report serves as a good indicator of the opinions of people in large urban areas, concerning large scale transit systems.

User Information Aids
Transit Marketing Management Handbook

By Allum Associates, Inc. Seattle, Washington and Cleveland
November 1975

For Urban Mass Transportation Adminstration,
Office of Transit Management
U.S. Department of Transportation

Purpose: The handbook was prepared to assist the professional in public transport in the design and/or improvement of user information systems.

Contents: Comprehensive study on all aspects of transit information aids. One section on Audio-Visual/Electronic components is particularly concerned with innovation. The section includes discussion on cattrode ray tubes (CRT), digital displays and path finders. The pathfinder is a device which alows the transit user to view the bus route by simply pressing a button, this displays the route on a road grid. Transfer points can be found by depressing the buttons of both routes.

Comments: The report itself is a series of researched recommendations rather than, an account of a study, which would include conclusions and statistics.

The report acts as a source of ideas without trying to recommend one specific system that is considered best.

Transit Telephone Information Systems

By The Mitre Corporation March 1973
Washington, D.C.

For Urban Mass Transportation Administration
Department of Transportation

Purpose: intended as a guide for transit systems to create or modify an information system basically concerned with the telephone but other information aids are examined.

Contents: Mostly a detailed analysis of telephone information systems.

Covers sections on; estimating volume of inquiries, numbers of required staff, determining work shifts and hours of operation, operator functions, staff selection and training, telephone equipment requirement, reference material requirements, work space requirements, estimating system costs, system implementation.

Also there are sections on regional information systems and alternate methods of communicating transit information.

Several interesting facts are raised

1) Most of operators time is spent in communication with the caller, rather than searching for information. Thus reduction in search time will have only a limited effect on system productivity.

2) The section on regional information systems included a discussion on the problems expected to arise in implementing a regional information network.
a) Incompatibility of operating procedures and conflicting goals for the information service.
b) Patrons must be informed of all appropriate services offered by all the participating companies. The information given can be reduced if the transit user defines their requirements to a finer level, i.e. a specific transit operator.
c) Information reference materials differ in layout and binding. This increases costs due to increased training time for the operators and in preparing a unified set of information. These extra costs can be reduced or eliminated if the companies involved can agree on a common format.
d) Communication problems are greatest at the time of initial set up, thus increased personnel are necessary
e) Competition between transit systems in the network i.e. one company advertises heavily but its business could go to another nonadvertising company.

3) Other methods of cooperating between companies are also examined.
a) Exchange of printed information materials between individual information systems
b) The exchange of information personnel for training purposes.
c) Inter-company telephone links

4) Alternate methods of communicating transit information are examined, the cost of 15-30¢ per call can often make the telephone information system too expensive for some companies.

Alternate Methods are:

a) schematic pocket sized maps
b) extensive advertising
c) display advertising and information signs

5) Certain points are raised concerning feedback information while travelling.
a) At any moment in time passengers should know their approximate location.
b) Passengers should be able to ascertain their destination stop approximately 1 minute before they arrive
c) Bus stop signs should be readily visible from the bus
d) Travel time between stops should be indicated on the route maps.

The Generation of Intergrated Public Transport Travel Information by Computer - 1980

By M.W. Pickett Transport and Road Research Laboratory

For Department of Transport, U.K.

Purpose - The use of a computer to compile travel information is of benefit to both travellers and operators by providing facilities for quicker, more accurate replies to enquiries.

Contents

1. Problems with present system
   - must rely on the expertise of the information clerk which is sometimes questionable
   - failure to consider valid route alternatives
   - organization only familiar with its own routes
   - information sometimes given too fast, rushed..

2. The TRRL Software

   i) input of timetable data
   - entered at minicomputer terminal
   - data converted and condensed
   - intermediate stopping times calculated

   ii) Criteria Incorporated
   - output free from unnecessary interchanges i.e. no backtracking or looping through the same exchange more than once, unless beneficial.
   - accomplished by the incorporation of logical algorithims.
   - optimum routing according to different criteria i.e. quickest, easiest, cheapest, etc.
   - fare information can also be made available.
   - can specify type of transit mode to be used
   - software takes account of all route conditions

   iii) selection of routes with walk links
   - if transfer points are close enough a walk link can be specified along with a walking-time allowance.

   iv) interchange times - routes are supressed if the exchange time at a transfer point is too long.

   v) Output of the Travel Information Software
   - The printout of route information is on 132-column 66-line computer page.
   - Each page holds information on 10 different routes.
   - Each schedule has a conterpart return trip schedule linked by a route code.
   - The origin and destination points can be specified as zones rather then specific locations.

3. Other applications
   - planning purposes
   - information sheets that can be posted
   - checks on route connections, especially using the walking-time allowance

4. Testing
   - tested in Wiltshire county, England
   - tests were successful, no results published

Conclusion - Due to the largely uncoordinated network of public transport services in Great Britain there is a need for improved information systems, manual methods are unsuitable due to the cost amount of information.

The computer software which was tested has been found to solve the information problem of intercity travel.

Study of Commuter Choice of Information Source to Improve Transit Information Systems - 1979

By Richard K. Robinson, M.M. Bakr, Thomas L.Thomson

For Transportation Research Board

Purpose - to gain a better understanding of information source choice behaviour and to suggest a way it can be applied to the improvement of transit information system design.

Contents

1) Method
   - project consisted of three parts
     i) the development
     ii) field demonstration
     iii) evaluation of experimental bus stop signs
   - before and after surveys were conducted to find the commuter information retreval patterns.
   - originally the bus stops simply consisted of a sign with the words "bus stop" on it
   - the bus stop that was developed had a graphic bus symbol along with the route number, name and space for additional information

2) Results
   - the results focused on two questions
     a) whether differences in the commuter information retreval patterns involving the experimental bus stop sign were statistically significant
     b) whether commuters choice of information source was significantly related to the personal and trip characteristics of the respondents

   The results of the before survey showed that the bus driver was the most common source of information for "Bus Routes and Transfer Points", as well as for "Bus Stop locations" with 45.3 and 38.8% of respondents respectively. The ineffectiveness of the bus stop is obvious with only 1.2% of people using it as a source of information on "Bus Routes and Transfer points" and 19.8% using it to find the bus stop location. When the new stop was installed these figures changed to 4.1% and 23.6% respectively.

   The following variables were found to be significantly related to information source choice; age, sex, education, race, trip purpose and need for bus transfer.

3) Information - Source choice model
   - depicts the normal behaviour of a transit consumer as based on acquired data from this and other surveys.

i) Attitudes toward transit information sources
- influenced by personal characteristics and by the the experience of the commuter
- affected by the commuters perception of information source characteristics i.e. complexity
- females, older people and less educated individuals preferred direct inquiry i.e. telephone information
- users with an automobile available tend to prefer direct inquiry as well

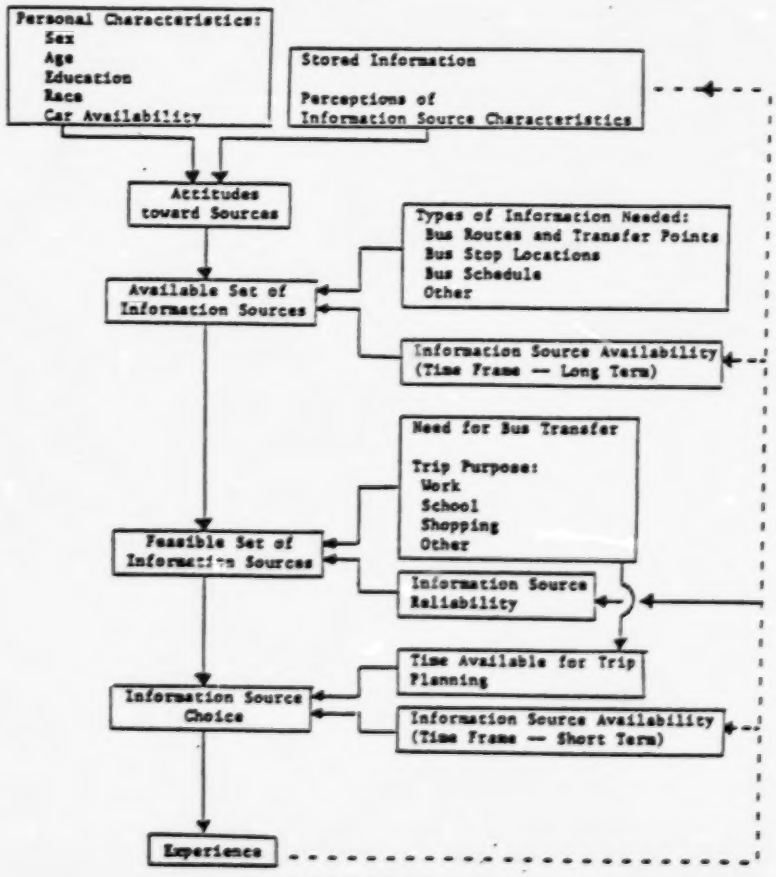
ii) Available set of information sources
- The set of sources considered available by the user is influenced by the users perception and attitudes toward the information sources, type of information desired and availability of the sources.

iii) Feasible set of information sources
- subset of available sources
- determined by; the reliability of available information sources, the nature of the trip, and the need for a transfer.

iv) Information source choice
- depends on
  a) the time available for trip planning
  b) availability of information source when the decision to undertake the trip is made

4) Implication for transit system management
- model helps to determine shortcomings in public information systems
- model helps to determine alternate strategies and the benefits or drawbacks of each approach

5) Model



Monitoring Report - Sudbury Automatic Vehicle Monitoring System
August 1979

Purpose - Sudbury Transit installed an Automatic Vehicle Monitoring (A.V.M.) system to try to monitor and control the schedule adherence of the bus fleet, at a reasonable cost.

Contents

1. Description of the system

i) Objectives
- improve schedule adherence of buses which would lead to increased ridership
- monitoring of vehicle mechanical malfunctions from central control
- remote silent alarm, actuated by bus driver and received at central control

ii) Basic Operation
- system name is Motorola "Metrocom" A.V.M.
- high speed digital data system used with a conventional 2-way radio
- uses the fixed route, fixed reference method called the signpost technique.
- small transmitters are situated at key points in the transit system
- when a bus passes through a signpost area a coded message is picked up and stored.
- when the bus leaves the area a distance register is triggered and records the distance travelled relative to the last signpost
- to obtain information on the bus location the bus code number is keyed into the A.V.M. control center which causes the bus to transmit its location
- the location information can be displayed by indicating it on a city map, hard copy printout or digital display
- the system consists of 4 components
  a) communications control center
  b) radio base station
  c) signpost transmitters
  d) mobile equipment (on-board bus: radio, data support unit, control head)

iii) Operational Features
a) Vehicle performance status and alarm
  - alerts the inspector about a vehicle malfunction
b) Emergency Vehicle Alarm
  - silent operator controlled alarm
c) Selective signalling
  - dispatcher can selectively call any bus or can select groups or all of the buses
d) Alarm Test
  -checks to see if the system is operating

2. A.V.M. - Technical Problems

i) Start-up Problems
- foreign electronic interference
- difficulty in adjusting units to operate reliably
- special coaxial cable was required to transmit the signal from the receiver to central control

ii) Design Problems
- unsatisfactory mounting of the radio and data support unit on the buses
- malfunctioning of the digital data printer

3. Monitoring Test Results
- The test data indicated a slight improvement (7.8 - 10.5%) in schedule reliability subsequent to the installation of the A.V.M.
- 2 factors made analysis of the system difficult
  i) Sudbury Transit did not quantify their objectives for the A.V.M. system
  ii) numerous technical problems

4. System Costs
- The total system original cost $142,139 as opposed to $114,800 & $86,500 for 2 schemes which involved the hiring of inspectors. The first scheme involves hiring 2 full time inspectors while the second involves 1 full time and 1 part time inspector.
- The systems cost outweigh its benefits at the present time but this is expected to be reversed in approximately 5 years.

A report - Transit Information Aids
Mass Transportation Demonstration Project - 1970

By Washington Metropolitan Area Transit Commission

For - Urban Mass Transportation Adminstration
U.S. Department of Transportation

Purpose - to test out what the public knows or does not know about the Washington Transit system, what kinds of information people need and how this information can best be supplied.

Hypotheses and Conclusions

More and better information aids would;

1. Increase the number of riders using more than a single route.
   No conclusion could be made although it was observed that most people use the same few routes repeatedly

2. Improve attitudes towards public transit
   No observed changes were observed, people tended to have a general favorable attitude towards the transit system.

3. Increase predisposition to use public transit.
   No observable changes observed.

4. Increase knowledge of sources of information about the D.C. Transit system.
   Increase in awareness of schedules and route maps as a source of information after 150,000 timetable folders had been distributed.

5. Increase knowledge of transit system as a whole.
   Not tested since appropriate information aids were not provided.

6. Decrease satisfaction with information currently offered.
   No dissatisfaction observed with old information. Tends to indicate that people take for granted information aids and feel no dissatisfaction with the existing aids.

7. Improve the quality of imformation given by D.C. Transit Drivers.
   Not Tested.

Contents:
There were some observations made during the study.

1) The increase in ridership was observed most in areas where information is supplied to people least likely to seek it out themselves.

2) Information which aids the regular rider is more important than that which aids the occasional rider.

3) Route markers, even though well sealed, were susceptible to mildew, vandalism is also a problem.

4) Signs mounted on boarding doors so that the route number would be at right angles to the side of the bus. These signs had two advantages, first they were easy to see and second it allowed the buses to park much closer together.

A detailed telephone survey was done which could be of some use.

Information and Control Systems for Paratransit Services
Urban Transport/Service Inovations T.R.B. S.R.#184 1979

By Nigel Wilson and Neil Colvin, Center for Transportation Studies, Massachusettes Institute of Technology

Purpose: A review of the current uses of information and control systems in paratransit services and a discussion of new applications currently being developed.

Contents: The section on conventional transit discusses customer information and examines the problems of telephone operator systems. The operator must rely on their own knowledge and supplement this knowledge with printed matter.

Two alternate systems have been implemented or planned. The first system uses microfiche to store the route information and can be recalled mechanically or computer assisted. In Chicago the mechanical recall is used, the system originally cost $30,000 and reduced operator training time by 90 percent, this system was set up by the Chicago Transit Authority. With the computer assistance added to the first system this reduced access time by operators to less than 10 seconds and a time saving of 15 to 20 percent over the mechanical retrival, this system was set up by the SouthEastern Pennyslvania Transportation Authority. The second type of system uses a computer data base as set up in Mississauga. The author comments that Canada is ahead of the U.S in this field. The cities of Washington D.C. and Los Angeles are also planning fully computerized customer information systems.

The computer data base can be easily changed if services change and can present more alternatives than one route. There is disagreement on the benefits of automation and as of yet the idea hasn't caught on.

The report also discusses transportation brokerages which acts as a interface between, those people supplying transportation and those who require it. The broker attempts to match the requests of the customer and provides the customer with all reasonable alternatives.

This type of operation lends itself to automation very well. The information system could be a time-sharing computer or a microcomputer. The system gets the most benefit of computerization in large urban areas, such as Knoxville Tennessee where it is now set up. The brokerage can also match carpools and vanpools along with public transit.

Conclusion: The advances in computer technology and the reduction in cost make the arguments for automation in customer information much stronger. No other conclusion were made in the report.

The AFI System -An Update

The AFI system is a computer-based route alternative choosing service which is being tested in Hamburg West Germany.[1] The AFI system has been evaluated,in terms of user opinion, three times up to February 1980.

The first evaluation was in August 1979. 10,000 households had available to them a 300 page booklet on how to use the service. This booklet included all the codes for using the AFI service, along with a preprinted note pad for recording travel information. Also supplied to the 10,000 households was a questionaire for recording reactions concerning the service.

The actual study was done with 1500 households which were selected to provide a representative cross-section of Hamburg. In these households 90.3% of the people found the telephone information understandable. The system recieved up to 300 calls per day from these households. At this time the information was changed to supply fare structures and route modifications to the users. The conversion of the database to winter route format was under way

In September 1979 a second survey was conducted using the same 1500 households. Of the tested households 28% had used the AFI service since the start of the test. Of these 28% half had access to cars. One quarter of telephone requested AFI information was actually used for a transit trip. Fourteen percent of the people interviewed said that AFI had influenced them to use public transit, otherwise they would have used private vehicles. The majority of requests were made for routes not normally taken. The surveyed group had a positive feeling towards the system in 75% of the cases and had

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[1] See appendix Trial Operation of a Computer Controlled Transit Information System (AFI) for Passengers in Hamburg

little difficulty in understanding the synthetic voice. At the automats 60% of recommended trips were made.

The latest survey of which information is available was conducted in February 1980, the same 1500 households were used as in the last survey.Of the 288 households reached 85% still had their code book and 30% had used AFI in the last week. The proportion of requested trips used went from 23 to 79 percent from the previous survey. The number of people influenced to use public transit by AFI was 16% over the previous 6 months

The AFI service was planned to be expanded and changed. Nine office locations, up from five in February 1980 were to be set up for the telephone service. The AFI service would be able to handle a specified arrival time condition and the synthetic voice would be inproved. By mid-April 1980, the research team hoped to test 1500 new households along with hotels and old peoples homes on their reactions to AFI. The final stage of development making AFI available to all households in the Hamburg area was started.

The interested results that are demonstrated by this research are: the use of public transit because of AFI (14% in Sept. 1979, 16% in Feb. 1980) and the vastly increased number of AFI generated itineraries that are actually used for trips. The use of public transit because of AFI is an interesting fact, because it shows that AFI is having an effect on transit use and in the future should have significant effects on ridership. The large increase in the itineraries that are actually used is due to less experimentation by the service users. Thus more serious calls are recieved.

Automatische Fahrplninformation(AFI) Grobtest über Telefon in Hamburg, Nahverkehrs-praxis Nr. 11/1979, p.503

Erfolgreicher Probebetrieb mit dem automatischen Fahrplan-informations - und Auskunffssystem AFI Verkehr und Technik 1980,page 303

Automatic Vehicle Monitoring
Current World Situation

The following page list the current status of AVM in the world. Of those projects listed only Mississauga is listed as combining AVM and passenger information, once again demonstrating that Canada tends to be more advanced in this field than other countries. In the last few years the following trends have emerged concerning AVM :

1. The shift in the last few years from experimental AVM to phased introduction of actual systems.
2. The emergence of Germany, Switzerland, France, Canada, and the U.S. as leaders in the field.
3. Steady expansion , especially since 1977 when the last of the experimental projects were completed
4. The decisions of Hamburg (1975), Zurich (1977), and Dublin (1978) to expand their first stage projects.

At the present time there are approximately 3000 buses involved in AVM projects around the world in about 25 separate projects.[1]

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[1] Mass Transport, February 1980 pg. 92-93, 103

Table 1 AVM SYSTEMS: AN INTERNATIONAL SUMMARY

City/country	Year initiated	System name	Original target	No. of vehicles	Main supplier	Current status
London, U.K.	1958	BESI	Simple AVL	240		Life expired
Hamburg, F.R.G.	1969	HHA-AVM	Limited AVM	165	Prodata	Active/expanding
Chicago, U.S.A.	1970	Monitor CTA	AVM demo	570	Motorola	Terminated
Zurich, Switzerland	1971	Dacosyst	Limited AVM	150	Hani-Prolectron	Active/expanding to full
Paris, France	1973	SECAMA	AVM demo	35	Matra	Terminated (1976)
Bristol, U.K.	1973	B-Line	AVM demo	100	Marconi	Withdrawn (1974)
London, U.K.	1973	CARLA	AVM demo	44	Marconi	Concluded (1979)
Tokyo, Japan	1973	Tokyo AVM	AVM demo	75	Tokyu	Completed
Nottingham, U.K.	1974	VETAG	Limited AVD	8	Philips	Active
Dublin, Ireland	1974	CIE/AVM	Phased AVM demo	900	Storno	Active/expanding
Toronto, Canada	1974	CIS	Phased AVM demo	100	—	Pilot/evaluation
Nagoya, Japan	1974	NRC/AVM	AVM demo	17	Denso	Completed
Besançon, France	1974	CTB/AVM	AVM demo	60	Thomson CST	Active/completed
Toulouse, France	1975	CGA/AVM	AVM demo	16	C.G.A.	Terminated
Brescia, Italy	1976	R-22-TO1	Phased AVM demo	90	Italtel	Demo suspended-strike (1977)
Cincinnati, U.S.A.	1976	UTL/AVM	Phased AVM demo	30	GM/Motorola	Active/evaluation
Hanover, F.R.G.	1976	RVL-I	AVM demo	150	Bosch	Evaluation
Berne, Switzerland	1976	"Economy AVM"	AVM pilot	12	Hani-Prolectron	Expanding
Stockholm, Sweden	1977	BTL	AVM pilot	60	Datasaab	Evaluation
Friedrichafen, F.R.G.	1977	Rufbus	DRT + AVM	12	Dornier	Active demo
Graz, Austria	1977	"Standard AVM"	Full AVM	225	Hani-Prolectron	Active
Mississauga, Canada	1977	ABPI	AVL + info. system	35	—	Active/expanding
London, U.K.	1978	BUSCO	AVM demo	50	—	Pilot project
Wunstorf, F.R.G.	1978	R-BUS	DRT + AVM	5	MBB	Active demo
Strasbourg, France	1978	SIRAC	Full AVM demo	180	C.G.A.	Being developed
Gothenburg, Sweden	1979	AVCS	Parallel demonstration projects for combination taxi-dispatching/AVL system. Developed by Volvo and SRA Communications with Swedish Taxi Drivers Organization.			
Malmo, Sweden	1979	AVCS				
Stockholm, Sweden	1979	AVCS				
Darmstadt, F.R.G.	1979	"Standard AVM"	AVM pilot	80	Hani-Prolectron	Being developed
Rome, Italy	1979	R-22-TO 1	AVM pilot	37	Italtel	Being developed
Regensburg, F.R.G.	1979	LIO	AVM pilot	15	Siemens	Being developed
Wiesbaden, F.R.G.	1979	LIO	AVM pilot	25	Siemens	Being developed
Augsburg, F.R.G.	1979	LIO	AVM pilot	25	Siemens	Being developed
Los Angeles, U.S.A.	1979	SCRTD AVM	AVM demo	200	Gould	Being developed
Melbourne, Australia	1980	MMTB AVM	Phased AVM demo	60 (first stage)	—	Tenders
Johannesburg, S. Africa	1980	—	AVM pilot	20-30	—	Tenders

Source:
1979 EcoPlan Status Report on AVM Development and Prospects

American Cities over 1 million (Metropolitan Area)-Nov. 1978 UITP

City	Transit System Name	Pop.x10^3	Buses
Atlanta	Metropolitan Atlanta Rapid Transit Authority	1687	783
Baltimore	Mass Transit Administration of Maryland	1601	969
Boston	Massachusetts Bay Transp. Authority	2996	1215
Buffalo	Niagara Frontier Transp. Authority	1312	483
Chicago	Chicago Transit Authority	7200	2400
Cincinnati	Southern Ohio Regional Transit Authority	1100	420
Cleveland	Greater Cleveland Transit Authority	1715	840
Columbus	Central Ohio Transit Authority	1051	273
Dallas	Dallas Transit System	1339	407
Denver	Regional Transportation District	1047	530
Detroit	Southeastern Michigan Transp. Authority/ Department of Transp. City of Detroit	3971	1272
Houston	Houston Transit System	2124	438
Los Angeles	Los Angeles County Transp. Comm./ Southern California Rapid Transit Dist.	6987	2391
Miami	Office of Rapid Transit Development/ Metropolitan Dade County Transit Agency	1450	690
Milwaukee	Milwaukee County Transit System	1420	523
Minneapolis-St. Paul	Metro. Transit Comm.	1704	982
Newark	Transport of New Jersey	1999	1959
New Orleans	New Orleans Public Service Inc.	1094	455
New York	The Metropolitan Transp. Authority/ New York City Transit Authority	7800	4550
Oakland	Alameda Cotra Costra Transit District	2988	826
Philadelphia	Southestern Penn. Transp. Authority/ Port Authority Transit Corp.	3775	1660
Phoenix	Phoenix Transit Corp.	1086	134
Pittsburg	Port Authority of Allegheni County Transit Div.	2285	903
San Francisco	San Francisco Municipal Railway Bay Area Rapid Transit District	3140	501

San Diego	San Diego Transit Corp.	1368	362
Santa Ana/ Orange Cty.	Orange Cty. Transit District	1700	324
Seattle	Municipality of Metropolitan Seattle	1266	593
St. Louis	Transit Division Bi-State Development Agency	2300	996
Washington	Washington Metro. Area Transit Authority	2500	2187